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TECHNICAL MEMORANDUM

(TM Series)

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Program Design Specifications for Modifications to MULTICON

by

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1 April 1963

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1.0 INTRODUCTION

This document gives the program design specifications for accomplishing the modifications to MULTICON listed in TM-(L)-890/007/00 and TM-(L)-890/007/00A.

2.0 TASK I - SPLICE

2.1 PURPOSE

SPLICE replaces the old PATCH function. Like PATCH, the SPLICE function prepares the data input to the MULTICON system. SPLICE does not rewind or write an end of file on the output tape. If the set of data generated by SPLICE is to be the first set on the output tape, a separate function (e.g., REWIND) is referenced for this task before calling SPLICE. A set of data is defined as a header record, acquisition data records (identified by a D in character two), and an end of data record for the vehicle designated on the SPLICE function card. Sets of data for more than one vehicle can be written on a SPLICE tape file by repeatedly calling SPLICE. End of file is written by a separate function (e.g., WEOF).

2.2 METHOD

A listing of station acquisitions is generated for all stations in the LOOK Table, for the interval of time designated on the SPLICE function card, by calling the ACQTABLE Function as a subroutine. Mod AB of the ACQTABLE Function is used to produce an acquisition table format of two words per entry:

Word	Bits	Contents
0	47-24	Revolution number
	23- 0	Station Number
1	47-26	Duration
	25- 0	Mid-time

Maximum elevation is computed by SPLICE, using subroutine TTE.

A set of data is automatically placed on the output tape each time the function SPLICE is called. Acquisitions over a long time interval are possible, since the ACQTABLE Function is repeatedly called automatically by SPLICE until all of the acquisitions for the entire interval are found.

The output records consist of 80 BCD character records and are compatible with punched cards. The output data consists of the following: a vehicle number; station number and name; revolution number (to the nearest tenth); date of rise time; rise time in hours, minutes, and seconds; fade time in hours, minutes and seconds; pass duration in hours, minutes, and seconds; maximum pass elevation; sequence number; and run identification. See Appendix B for the SPLICE tape format.

2.3 FUNCTION CARD FORMAT

*SPLICE A B C D E F G H I J K L

where:

A = vehicle number

B = month
C = day
D = hours
E = minutes
F = seconds (floating)

} Start Date

G = month
H = day
I = hours
J = minutes
K = seconds (floating)

} Stop Date

L = tape number for output (if blank, output is on Tape Unit 5).

2.4 RESTRICTIONS

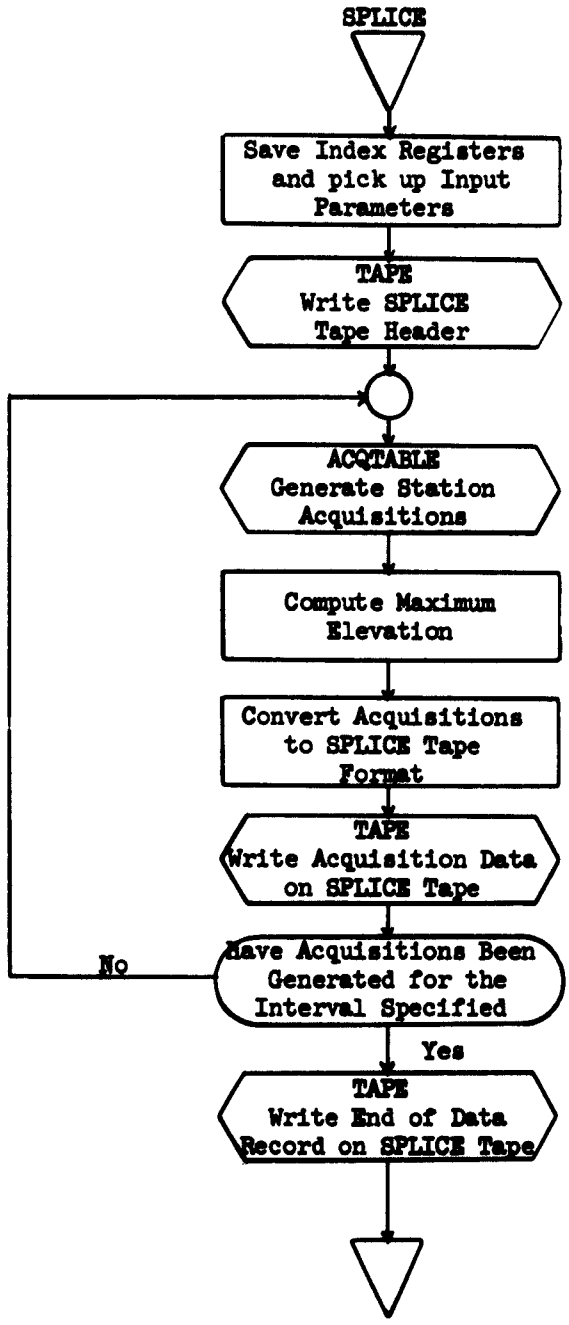
a. SPLICE does not rewind the output tape; therefore, a separate function (e.g., REWIND) is required for this task.

b. The methods of determining fade time in PATCH and SPLICE vary slightly. Therefore, a comparison of a MATCH (see Section 3.0) converted PATCH tape and a SPLICE tape might point out a one-second difference in fade time for a specific acquisition.

Fade time is computed in the following manner:

PATCH : Midtime + Duration/2 = Fade Time
SPLICE: Rise time + Duration = Fade Time

PATCH tapes contain only Rise and Fade times; therefore, MATCH must compute duration by finding the difference between these two times. SPLICE tapes contain duration obtained directly from RESETBL. Because of the above stated difference in Fade time, duration might also differ by one second.


SPLICE
Save Index Registers and pick up Input Parameters
TAPE Write SPLICE Tape Header
ACQTABLE Generate Station Acquisitions
Compute Maximum Elevation
Convert Acquisitions to SPLICE Tape Format
TAPE Write Acquisition Data on SPLICE Tape
Have Acquisitions Been Generated for the Interval Specified
No
Yes
TAPE Write End of Data Record on SPLICE Tape

3.0 TASK II - MATCH

3.1 PURPOSE

MATCH is used to convert an old or new format PATCH output tape to the format of a SPLICE output tape. See Appendices B and C for SPLICE and PATCH tape formats.

3.2 METHOD

The input PATCH tape is placed on Tape Unit 4 and the output SPLICE tape is on Unit 5. If an old format PATCH tape, which contains revolution number as an integer, is being converted, revolution number to the nearest tenth is written on the converted tape with the fractional portion set to zero. BCD blanks are written for maximum elevation. If the reference pool item, IDBCD, is not set by a separate function (e.g., RUNNUM), BCD blanks appear in the characters for tape identification.

Multiple file PATCH tapes can be converted by successive MATCH calls.

The MATCH function does not rewind the output tape so that a separate function (e.g., REWIND) is utilized for this task. An end of file is written on the output tape upon reaching the file mark on the input tape.

3.3 FUNCTION CARD FORMAT

*MATCH

No parameters are required.

3.4 RESTRICTIONS

Maximum elevation is set to BCD blanks.

The master tape routine TAPE is referenced for read and write functions.

3.4.1 On-Line Printouts

Errors incurred by the TAPE routine are noted by on-line error comments. After any of the following printouts, a stop is effected at the first logical instruction in MATCH.

a. End of file was read while trying to read PATCH header record.

EOF READ. TRYING TO READ PATCH HEADER. POSITION TAPE TO START OF FILE, START.

b. Buffer length error occurred while trying to read PATCH tape header. Either the PATCH tape was positioned incorrectly, or an illegal tape was mounted on Tape Unit 4.

BUFFER LENGTH ERROR. TRYING TO READ PATCH HEADER. POSITION TAPE TO START OF FILE, START.

c. Parity error on PATCH tape.

READ PARITY ERROR. DEPRESS START TO REINITIATE MATCH.

d. Parity error on output tape.

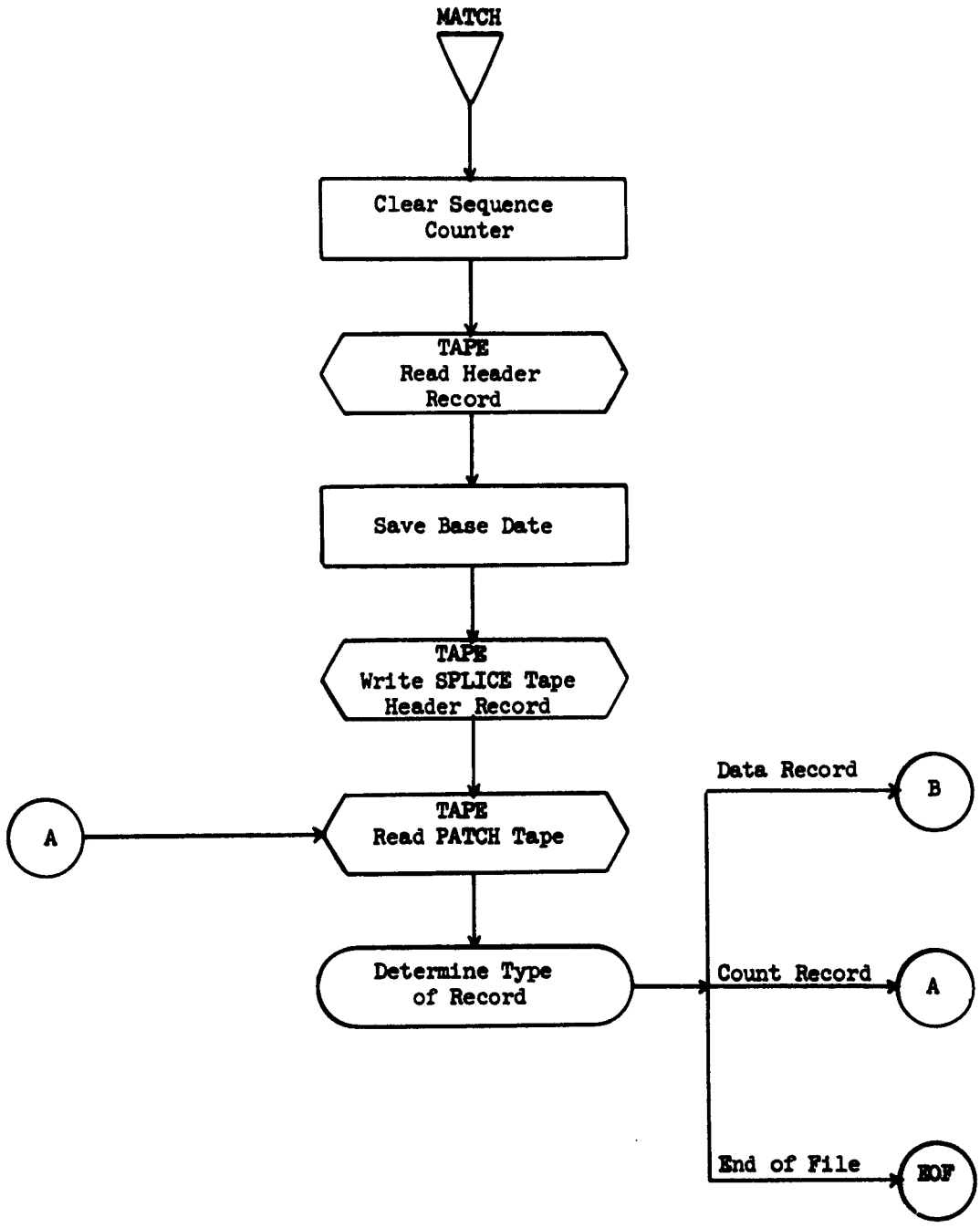
WRITE PARITY ERROR. REWIND TAPES, DEPRESS START TO REINITIATE MATCH.

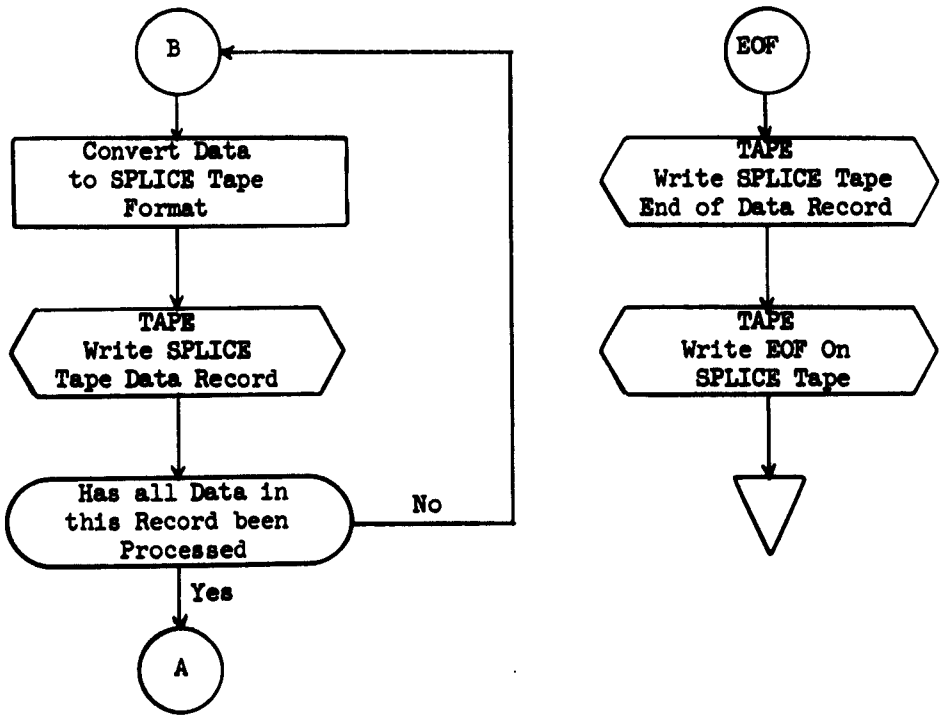
e. Output buffer length error.

WRITE BUFFER LENGTH ERROR. REWIND TAPES, DEPRESS START TO REINITIATE MATCH.

f. Output tape too short.

EOT. MOUNT LONGER TAPE ON UNIT 5, REWIND PATCH TAPE, START.


MATCH
Clear Sequence Counter
TAPE Read Header Record
Save Base Date
TAPE Write SPLICE Tape Header Record
A
TAPE Read PATCH Tape
Determine Type of Record
Data Record
B
Count Record
A
End of File
EOF


B
Convert Data to SPLICE Tape Format
TAPE Write SPLICE Tape Data Record
Has all Data in this Record been Processed
No
Yes
A
EOF
TAPE Write SPLICE Tape End of Data Record
TAPE Write EOF On SPLICE Tape

4.0 TASK III - MODIFY TAPEIN

4.1 PURPOSE

This modification enables TAPEIN to read a ten word per record SPLICE tape, rather than a PATCH tape with variable length records. See Appendices B and C for SPLICE and PATCH tape formats.

4.2 METHOD

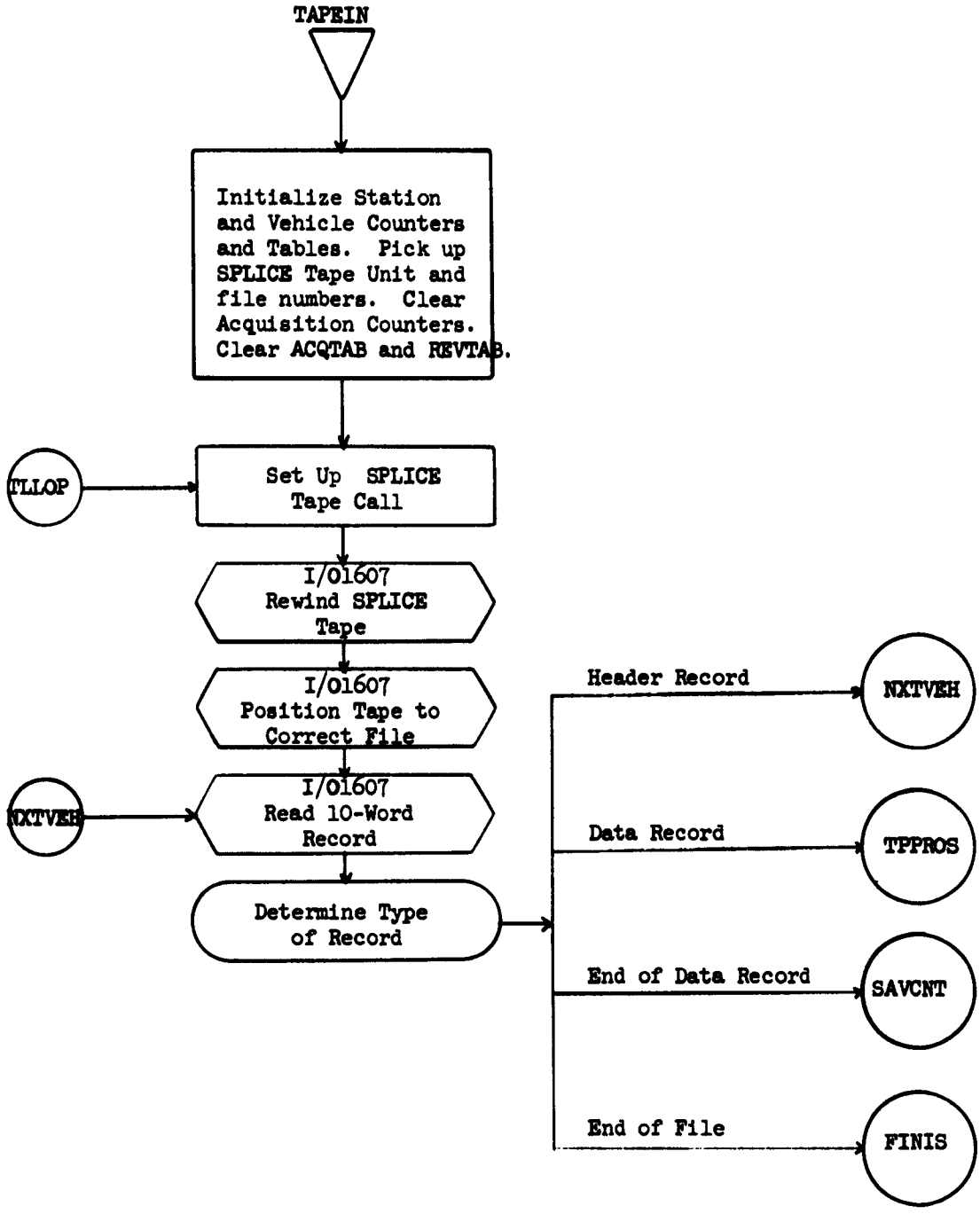
The I/O1607 Functions of MTCII are used for tape manipulation. Maximum elevation is stored in bits 24-47 of the REVTAB Table as a binary integer.

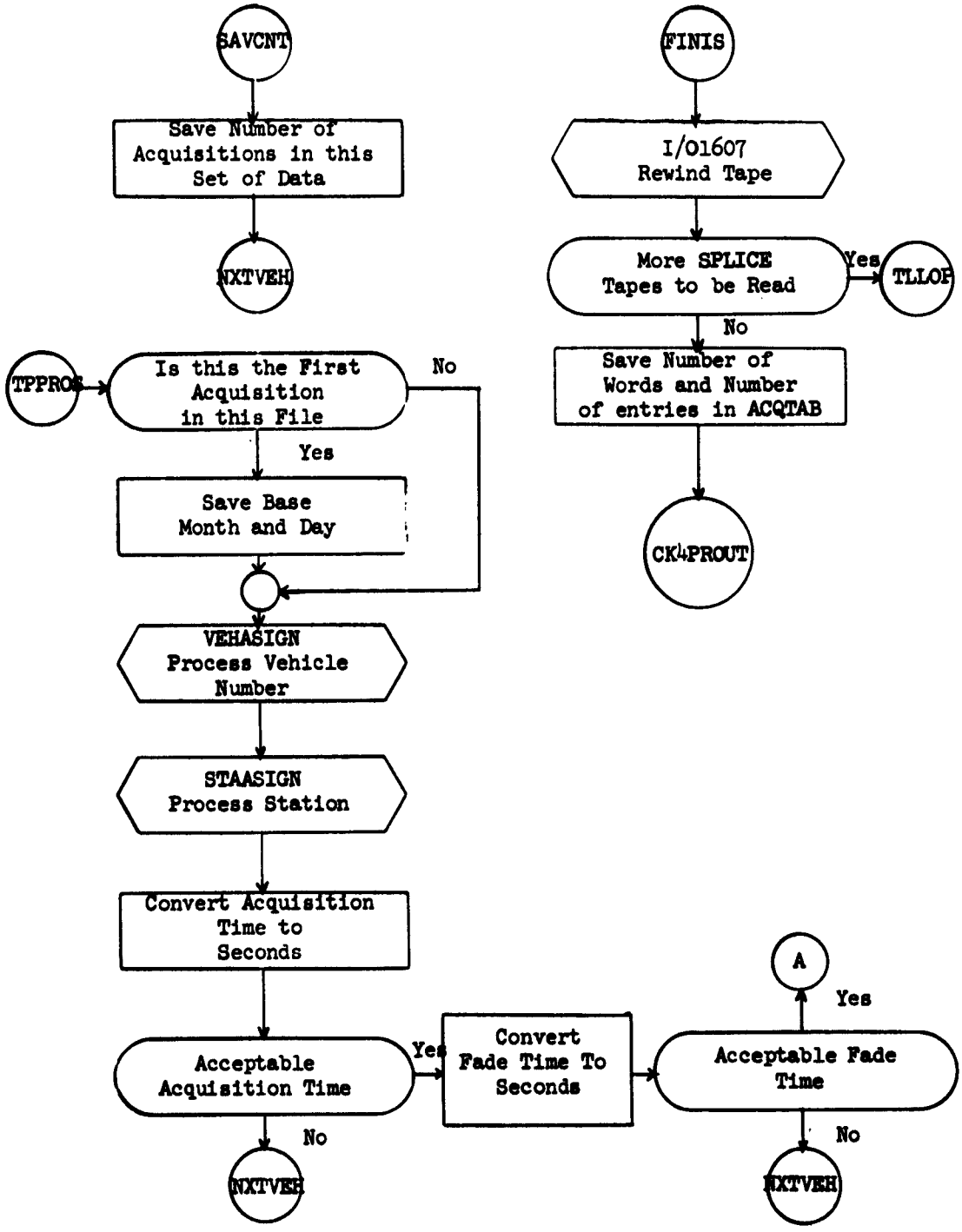
4.3 FUNCTION CARD FORMAT

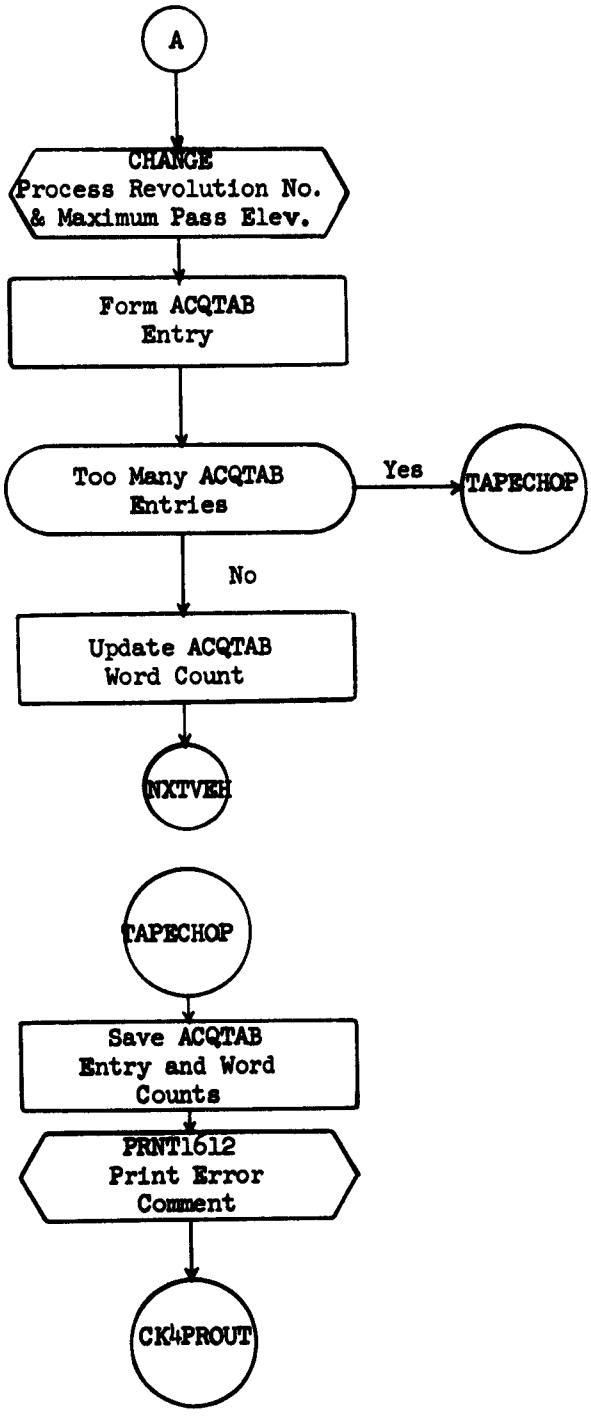
TAPEIN is referenced internally by MULTICON; therefore, no function card is required.

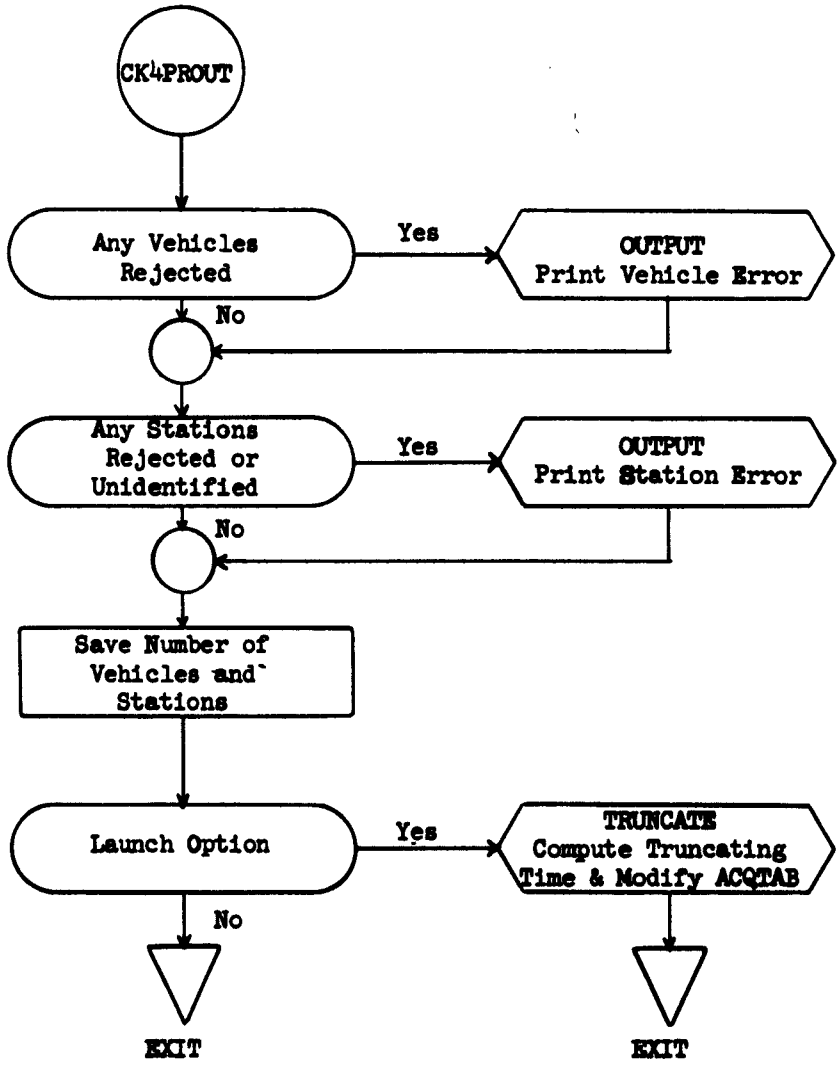
4.4 RESTRICTIONS

The REVTAB Table was originally designed to contain only revolution number, bits 0-47. The maximum revolution number can be contained in 24 bits, which leaves sufficient space for maximum elevation. This modification to Table REVTAB necessitates logical referencing of maximum elevation and revolution number in both the REVTAB and REVTABS Tables.


TAPEIN
Initialize Station and Vehicle Counters and Tables. Pick up SPLICE Tape Unit and file numbers. Clear Acquisition Counters. Clear ACQTAB and REVTAB.
TLLOP
Set Up SPLICE Tape Call
I/O1607 Rewind SPLICE Tape
I/O1607 Position Tape to Correct File
NXTVEH
I/O1607 Read 10-Word Record
Determine Type of Record
Header Record
NXTVEH
Data Record
TPPROS
End of Data Record
SAVCNT
End of File
FINIS


SAVCNT
Save Number of Acquisitions in this Set of Data
NXTVEH
TPPROC
Is this the First Acquisition in this File
No
Yes
Save Base Month and Day
VEHASIGN Process Vehicle Number
STAASIGN Process Station
Convert Acquisition Time to Seconds
Acceptable Acquisition Time
Yes
No
NXTVEH
Convert Fade Time To Seconds
A
Yes
Acceptable Fade Time
No
NXTVEH
FINIS
I/O1607 Rewind Tape
More SPLICE Tapes to be Read
Yes
TLLOP
No
Save Number of Words and Number of entries in ACQTAB
CK4PROUT


A
CHANGE
Process Revolution No.
& Maximum Pass Elev.
Form ACQTAB
Entry
Too Many ACQTAB
Entries
Yes
TAPECHOP
No
Update ACQTAB
Word Count
NXTVEH
TAPECHOP
Save ACQTAB
Entry and Word
Counts
PRNT1612
Print Error
Comment
CK4PROUT


CK4PROUT
Any Vehicles Rejected
Yes
OUTPUT Print Vehicle Error
No
Any Stations Rejected or Unidentified
Yes
OUTPUT Print Station Error
No
Save Number of Vehicles and Stations
Launch Option
Yes
TRUNCATE Compute Truncating Time & Modify ACQTAB
No
EXIT
EXIT

5.0 TASK IV - MAXIMUM ELEVATION ON STAOUT LISTING

The original STAOUT listing format allocated space for elevation in degrees, minutes, and seconds. This space is filled with BCD blanks, and is free to accept maximum elevation to the nearest degree, obtained from bits 24-47 of the REVTABS Table, generated by ABSAO from the REVTAB Table. One of the OUTPUT calls in subroutine MULTIOUT must be modified to include a conversion of maximum elevation.

6.0 TASK V - DOUBLE SPACING ON STAOUT LISTING

The MULTIOUT subroutine is used to list the various outputs of MULTICON. The STAOUT subroutine sets up the inputs to MULTIOUT to produce the STAOUT listing. Modification of the MULTIOUT OUTPUT carriage control character to 12 (octal), immediately preceding the reference to MULTIOUT in STAOUT, produces double spacing rather than single spacing. Upon return to STAOUT, the single space control character is replaced. The page eject control will also have to be adjusted for double spaced lines.

7.0 TASK VI - EQUIPMENT CHANGEOVER TIME

a. Subroutine SELECT will be modified so that changeover times will no longer need to be ordered and maximum changeover time will be found, and saved.

b. In subroutine EVALUATE, all changeover times will be tested to see if there is a changeover time conflict for the particular station and vehicle.

8.0 TASK VII - PLOT MULTICON OUTPUT (PLOT)

An attempt will be made to include PLOT as an integral part of MULTICON. The available core space can be utilized best by executing PLOT after all other listings have been made. Areas of memory, which are no longer required (such as the STACON buffer), can then be used as a storage area for PLOT.

The input to PLOT will be the acquisition messages ordered by acquisition time. An extra entry to MERGE will be needed to re-order the acquisition messages, since they are presently in vehicle order, at the end of MULTICON.

Appendix A contains a sample of the PLOT output. The day, month, hour, and minute are printed at the left for each minute between the first acquisition and the last fade. A letter in one of the 100 possible station-vehicle columns indicates that the vehicle can be seen by the station at some time during this minute. Revolution number is printed above the letters indicating the vehicle-station contact, and maximum elevation (in degrees) is printed below.

The numbers 1-9 separate the stations and aid in identifying them. Each page is completely filled, and there are no page headings after the first page.

PLOT will make use of six parallel tables, each one being 100 words long for the 100 possible station-vehicle combinations.

The entries in Table 1 will have the following format:

SOOOLLOOOCCWWWWW

S = 0 if the entry is inactive.

S = 4 if the entry is active.

LL = the vehicle letter for this entry.

CC = the shift count for positioning a character for this entry in the output word.

WWWWW = the location of the output word in the output buffer for this entry.

Table 2 will contain the SSU mask corresponding to the shift count in Table 1.

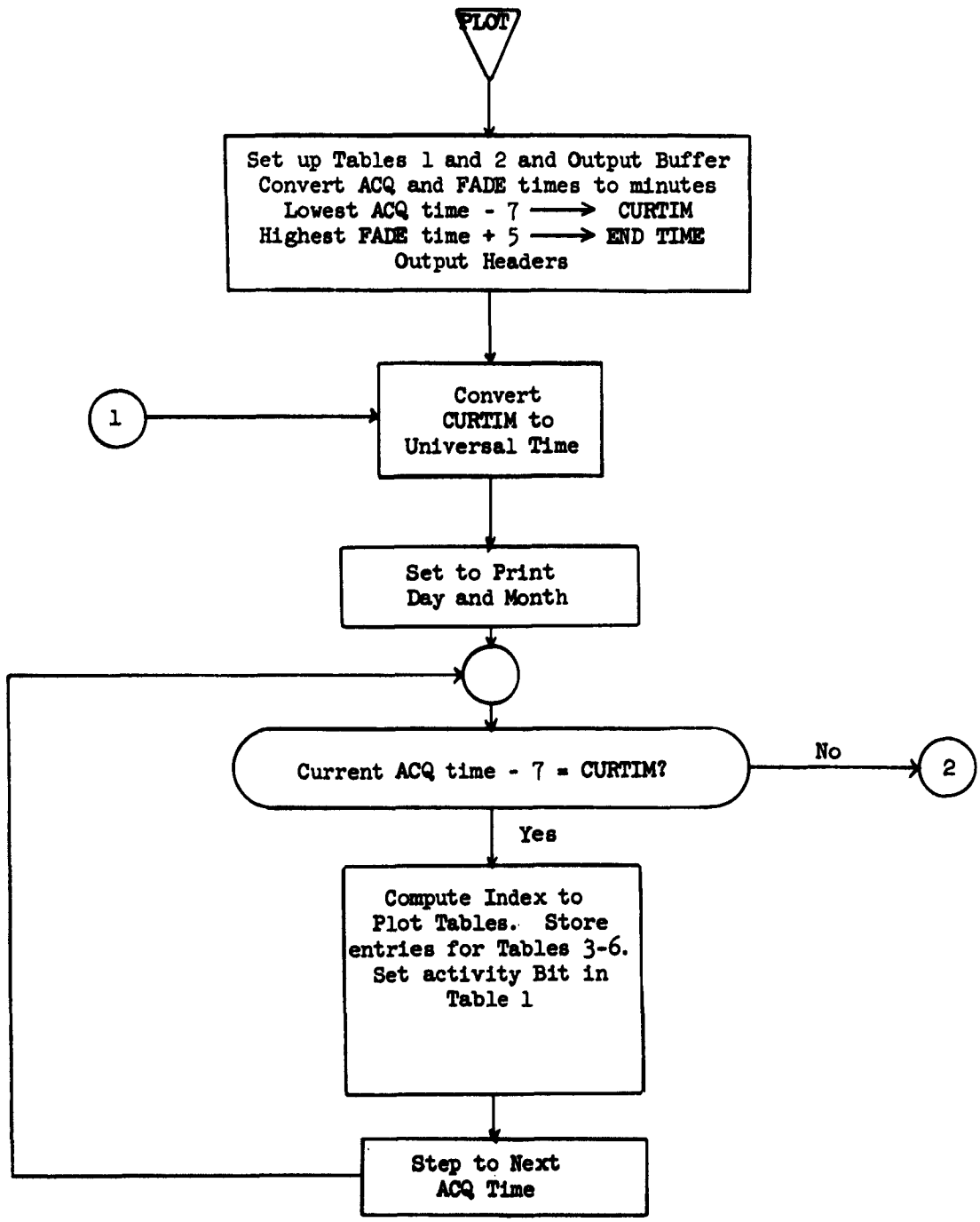
Table 3 will contain the minute during which acquisition occurs.

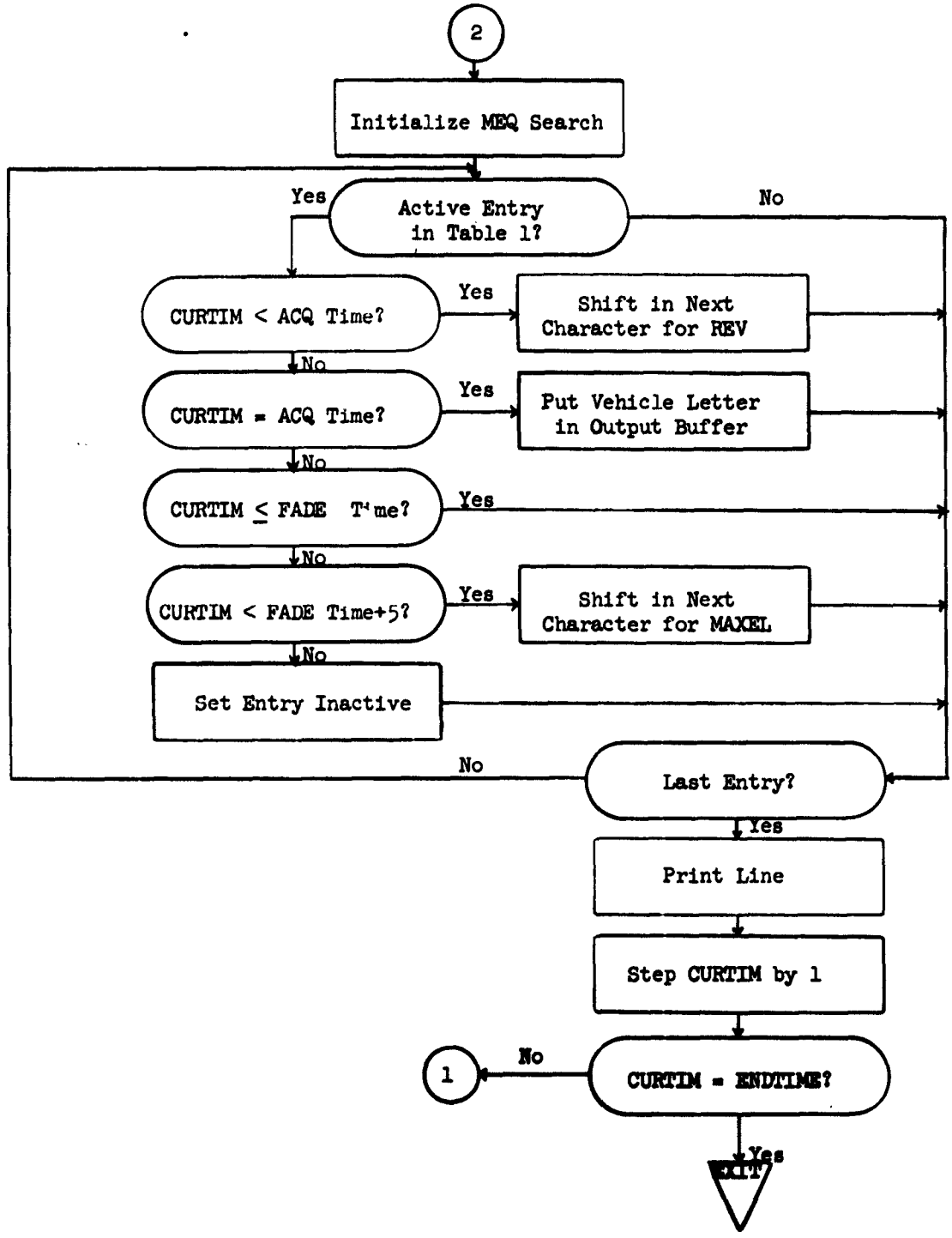
Table 4 will contain the minute during which fade occurs.

Table 5 will contain the revolution number, converted to BCD, left justified, with trailing blanks. As each character of revolution number is printed, the entry in Table 5 will be shifted left one character.

Table 6 will contain the maximum elevation (a blank plus two characters) converted to BCD, left justified, with trailing blanks. As each character of maximum elevation is printed, the entry in Table 6 will be shifted left one character.

For each minute of the plot, the acquisition message table will be checked for any upcoming station-vehicle contacts. If there are any, the "entry active" bit will be set in Table 1 and entries made to Tables 3-6. Then, Table 1 will be checked for active entries by doing a masked equality search on the sign bit. For each active entry, current time will be compared with the times in Tables 3 and 4 to determine which character should be entered in the output buffer. After maximum elevation has been printed, the "entry active" bit will be reset.


PLOT
Set up Tables 1 and 2 and Output Buffer
Convert ACQ and FADE times to minutes
Lowest ACQ time - 7 → CURTIM
Highest FADE time + 5 → END TIME
Output Headers
1
Convert CURTIM to Universal Time
Set to Print Day and Month
Current ACQ time - 7 = CURTIM?
No
2
Yes
Compute Index to Plot Tables. Store entries for Tables 3-6. Set activity Bit in Table 1
Step to Next ACQ Time


2
Initialize MEQ Search
Yes
Active Entry in Table 1?
No
CURTIM < ACQ Time?
Yes
Shift in Next Character for REV
No
CURTIM = ACQ Time?
Yes
Put Vehicle Letter in Output Buffer
No
CURTIM ≤ FADE Time?
Yes
No
CURTIM < FADE Time+5?
Yes
Shift in Next Character for MAXEL
No
Set Entry Inactive
No
Last Entry?
Yes
Print Line
Step CURTIM by 1
1
No
CURTIM = ENDTIME?
Yes
EXIT

9.0 TASK VIII - REVOLUTION NUMBER PRINTOUT

On the MERGEOUT and STAOUT listings, the extra column for revolution number will be obtained by moving the vehicle number one space to the left. The other listings already have the space available. The necessary changes require modifications to existing OUTPUT calls.

10.0 TASK IX - MODIFICATIONS TO "RESOLVE"

When a solution cannot be found for a station-vehicle matrix, the lowest priority vehicle will be deleted and the highest priority vehicle added in again to keep the matrix square. This process will be repeated, if necessary, until a solution is found.

In the above procedure (and also in the original "squaring" of the matrix), it is possible for the deletion of a vehicle to cause the matrix row for a station to become zero; i.e., the station cannot service any of the remaining vehicles. The matrix is insoluble if any row is zero. Therefore, the station will be deleted and the dimension of the matrix reduced by one. The lowest priority vehicle will then be deleted to keep the matrix square.

11.0 TASK X - LIST CONFLICT TIME

a. Conflict Time = |minimum fade time-maximum acquisition time| for two vehicles in a REALTIME or CHANGEOVER conflict.

b. Conflict Time will be added to the MERGEOUT, STAOUT, VEHOUT, and CONLIST listings. Subroutine MULTIOUT produces the MERGEOUT, STAOUT, and VEHOUT listings.

c. Conflict Time cannot conveniently be saved. It will be re-computed at the time of listing. STACON gives the acquisition times of the conflicting vehicles. The fade time can be obtained by searching for an entry with an equal acquisition time in the STARES Table.

d. Conflict time will be listed to the nearest minute. It will be placed between the revolution number of the conflicting vehicle and the type of conflict.

12.0 TASK XI - PROVIDE CORE SPACE FOR THE PRECEDING TASKS

The current version of MULTICON uses almost all of the core locations available under the COPII system. The following changes are intended to provide the extra core space needed to accomplish the preceding tasks.

a. Remove all uses of subroutines TAPE, INPUT, and EOT. Use MTCII's TAPEIO and CARDIO to accomplish the tasks now done by these subroutines. INPUT is only used to read the data cards. Conversion is done by GCIR. There is also an unused subroutine (INOUT8), which references INPUT, but which should be removed.

b. Remove MULTICON subroutine PR1612 and replace with MTCII's subroutine PRNT1612. Most of the calls to PR1612 will remain the same, but some may have to be modified.

c. Remove MULTICON subroutine CHEKEOT and all its references. The current version of OUTPUT checks for end-of-tape and error exits if it is detected. The error returns from OUTPUT will have to be changed.

d. Subroutinize the code in ABSAO, which sorts the acquisition messages into acquisition time order. Then, replace the sort code in MERGE with a call for the new sort subroutine. This will have the further advantage of reducing MULTICON's execution time, since the sort in MERGE takes about ten times longer than the sort in ABSAO.

e. Replace duplicate constants with EQU cards.

f. Use the same area of core for non-conflicting temporary storage. This has already been done for some of the MULTICON subroutines.

APPENDIX A

VEHICLE	CODE
3600	A
7094	B
1107	C
7070	D
1620	E

	COOK										TASC										ARDE										KODI									
DAY TIME	A	B	C	D	E	F	G	H	I	J	A	B	C	D	E	F	G	H	I	J	A	B	C	D	E	F	G	H	I	J	A	B	C	D	E	F	G	H	I	J
30JUN2350										1										2										3										4
30JUN2351				1						1										2										3										4
30JUN2352				6						1										2										3										4
30JUN2353	2			0						1										2	1									3										4
30JUN2354	6			.						1										2	9									3										4
30JUN2355	.			1						1										2	8									3										4
30JUN2356	5									1				0						2	7									3										4
30JUN2357				E						1				.						2	.									3										4
30JUN2358	A			E						1				4						2	0									3										4
30JUN2359	A			E						1										2										3										4
1JUL0000	A			E						1	2		C							2	B									3										4
1JUL0001	A									1	6		C							2	B		1							3										4
1JUL0002	A			6						1	.		C							2	B		6							3										4
1JUL0003	A			9						1	8		C							2	B		0							3										4
1JUL0004	A									1			C							2	B		.							3										4
1JUL0005										1	A		C							2	B		2							3		0								4
1JUL0006	3									1	A									2										3		.								4
1JUL0007	1									1	A		4							2	3		E							3		9								4
1JUL0008										1	A		2							2	6		E							3										4
1JUL0009										1	A									2			E							3		C								4

APPENDIX B

SPLICE Tape Format (BCD)

Header Record: 10 words

Characters:

5- 7 - FTV
10-16 - STATION
21-23 - REV
29-32 - DATE
37-40 - RISE
47-49 - SET
55-62 - DURATION
64-67 - ELEV
69-71 - SEQ
74-79 - RUNNUM

Data Record: 10 words

Characters:

2 - D
5- 8 - Vehicle number
11 - Station number
13-16 - Station name
19-24 - Revolution number
28-29 - Day } Date
30-32 - Month }
35-36 - Hour } Rise time
38-39 - Minute }
41-42 - Second }

45-46 - Hour
48-49 - Minute } Set time
51-52 - Second

55-56 - Hour
58-59 - Minute } Duration
61-62 - Second

65-66 - Maximum pass elevation

68-71 - Sequence number

73-80 - Identification

End Data Record: 10 words

Characters:

68-71 - Number of acquisition data records in this file.
74-78 - TOTAL

APPENDIX C

PATCH Tape Format (BCD)

Header Record: 5 words

Words:		
	0	- PATCH
	1	- Tape sequence number
	2	- BCD blanks
	3	- Month (biased)
	4	- Day (biased)

Data Record: usually 35 words (maximum) - this record can contain less than 35 words but the number of words will always be a multiple of 7.

Words:		
	0,7,14,21,28	- BCD blanks
	1,8,15,22,29	- Revolution number
	2,9,16,23,30	- Vehicle number
	3,10,17,24,31	- Station number
	4,11,18,25,32	- Acquisition time
	5,12,19,26,33	- Fade time
	6,13,20,27,34	- BCD blanks

End Data Record: 2 words

Words:		
	0	- 0000000
	1	- Number of acquisitions in this file.

The old and new format PATCH tapes differ in only one respect: revolution number on the old format tape does not contain a fractional part, whereas the new format tape shows revolution number in tenths.

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